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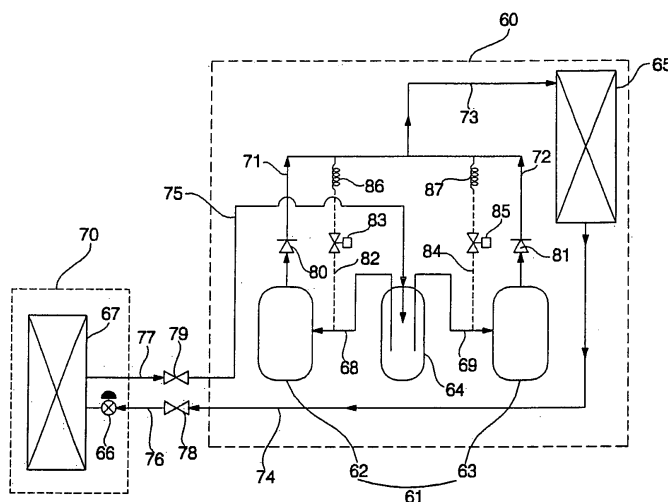
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(54) Air conditioner and method for controlling the same

(57) An air conditioner and a method for controlling the same are disclosed herein. The air conditioner has a capillary tube (86,87) equipped to a connecting tube which connects a suction pipe (68,69) and a discharge pipe (71,72) of a compressor (62,63) and has an opening/closing valve (83,85) equipped therein, thereby allowing pressure equilibrium between the suction pipe and the discharge pipe of a compressor to be maintained when

the compressor stops operating, and allowing a discharge flux of the compressor to be appropriately controlled when a load is lower than a capacity of the controller under operation. As a result, the air conditioner does not require a separate bypass unit, thereby simplifying the construction of the air conditioner while minimizing the installation space thereof through omission of a separate bypass unit, leading to reduction in costs.

FIG. 2



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an air conditioner, and, more particularly, to an air conditioner which has a capillary tube equipped in a pressure equilibrating member for maintaining pressure equilibrium in a compressor so as to control a capacity of the compressor while maintaining pressure equilibrium therein, thereby simplifying the construction and minimizing the installation space of the air conditioner, leading to reduction in costs, and a method for controlling the air conditioner.

Description of the Related Art

[0002] Generally, air conditioners serve to cool or heat a room via suctioning indoor air, and then discharging the indoor air after cooling or heating in order to provide a more pleasant indoor environment.

[0003] Fig. 1 is a constructional view schematically illustrating a conventional air conditioner.

[0004] As shown in Fig. 1, the conventional air conditioner comprises: a plurality of compressors 2 for compressing a refrigerant from a state of low temperature and low pressure gas into a state of high temperature and high pressure gas; an outdoor heat exchanger 8 for condensing the refrigerant in the state of high temperature and high pressure gas discharged from the compressors 2 into a liquid refrigerant while emitting heat through heat exchange with outdoor air; an expansion mechanism 24 for expanding the liquid refrigerant condensed by the outdoor heat exchanger 8 into a two-phase refrigerant combined with gas and liquid in low temperature and low pressure; and an indoor heat exchanger 22 for evaporating the two-phase refrigerant discharged from the expansion mechanism 24 into a gaseous refrigerant.

[0005] Meanwhile, the conventional air conditioner generally consists of an indoor unit 20 which has the indoor heat exchanger 22 and the expansion mechanism 24 equipped therein, and an outdoor unit 10 which has the compressors 2 and the outdoor heat exchanger 8 equipped therein.

[0006] Additionally, the outdoor unit 10 is provided with an outdoor refrigerant discharge pipe 12 for guiding the refrigerant discharged from the outdoor heat exchanger 8 into the indoor unit 20, and an outdoor refrigerant suction pipe 14 for guiding circulation of the refrigerant discharged from the indoor unit 20 into the outdoor unit 10. The indoor unit 20 is provided with an indoor refrigerant suction pipe 26 for suctioning the refrigerant from the outdoor unit 10, and an indoor refrigerant discharge pipe 28 for discharging the refrigerant from the indoor unit 20 to the outdoor unit 10.

[0007] Here, the outdoor refrigerant discharge pipe 12

is connected to the indoor refrigerant suction pipe 26 via a first service valve 30, and the outdoor refrigerant suction pipe 14 is connected to the indoor refrigerant discharge pipe 28 via a second service valve 32.

[0008] Meanwhile, the compressors 2 comprise two constant speed compressors, which are connected to each other via a common accumulator 34.

[0009] In other words, the compressors 2 comprise first and second compressors 4 and 6, which are provided at one side thereof with first and second suction pipes 36 and 38, respectively, which are connected to one side of the common accumulator 34. At this time, the other side of the common accumulator 34 is connected to the outdoor refrigerant suction pipe 14.

[0010] Moreover, the first and second compressors 4 and 6 are respectively connected to first and second discharge pipes 40 and 42 so as to discharge the compressed gaseous refrigerant of high temperature and high pressure, and the first and second discharge pipes 40 and 42 are finally combined with a third discharge pipe 44 which guides the refrigerant discharged from the first and second compressors 4 and 6 towards the outdoor heat exchanger 8.

[0011] The first and second discharge pipes 40 and 42 are equipped with first and second check valves 46 and 48 so as to prevent the gaseous refrigerant of high temperature and high pressure from flowing in reverse, respectively.

[0012] Meanwhile, the conventional air conditioner further comprises a pressure equilibrating member for maintaining pressure equilibrium between a suction part and a discharge part when one of the first and second compressors 4 and 6 stops operating.

[0013] The pressure equilibrating member comprises a first connecting tube 50 for connecting the first suction pipe 36 and the first discharge pipe 40 such that pressures between the suction part and the discharge part of the first compressor 4 are in equilibrium when the first compressor 4 stops operating, a first opening/closing valve 51 equipped to the first connecting tube 50, a second connecting tube 53 for connecting the second suction pipe 38 and the second discharge pipe 48 such that pressures between the suction part and the discharge part of the second compressor 6 are in equilibrium when the second compressor 6 stops operating, and a second opening/closing valve 54 equipped to the second connecting tube 53.

[0014] The conventional air conditioner further comprises a bypass unit for bypassing the refrigerant discharged from the first and second compressors 4 and 6 when a cooling load is lower in comparison to a capacity of the first and second compressors 4 and 6.

[0015] The bypass unit comprises a bypass pathway 56 for connecting the third discharge pipe 44 to the outdoor refrigerant suction pipe 14, a third opening/closing valve 57 for opening/closing the bypass pathway 56, and a capillary tube 58 for reducing the pressure of the refrigerant bypassing through the bypass pathway 55.

[0016] Operation of the conventional air conditioner constructed as described above will now be described in the following.

[0017] First, refrigerants compressed by the first and second compressors 4 and 6 and then discharged through the first and second discharge pipes 40 and 42 are combined in the third discharge pipe 44, and flow in the outdoor heat exchanger 8.

[0018] The refrigerant within the outdoor heat exchanger 8 is subjected to heat exchange with outdoor air to dissipate heat to the outdoor air while being condensed.

[0019] Then, the condensed refrigerant flows in the indoor unit 20 through the outdoor refrigerant discharge pipe 12, and is expanded into the refrigerant of low temperature and low pressure while passing through the expansion mechanism 24. The expanded refrigerant absorbs the heat of indoor air while passing through the indoor heat exchanger 22, and is finally evaporated.

[0020] Meanwhile, if a cooling load is lower in comparison to a capacity of the first and second compressors 4 and 6 under the operation, the third opening/closing valve 57 is opened, and then some portion of the refrigerant passing through the third discharge pipe 44 after being discharged from the first and second compressors 4 and 6 bypasses to the common accumulator 34 through the bypass pathway 56.

[0021] At this time, when passing through the bypass pathway 56, the refrigerant is reduced in pressure, and is then suctioned into the common accumulator 34 through the outdoor refrigerant suction pipe 14.

[0022] On the other hand, if the first compressor 4 stops operating, the first opening/closing valve 51 is opened, and the refrigerant discharged from the first compressor 4 flows in the first suction pipe 36 through the first connecting tube 50, and then flows again in the first compressor 4.

[0023] As a result, pressure equilibrium between the first suction pipe 36 and the first discharge pipe 40 of the first compressor 4 is achieved.

[0024] However, according to the conventional air conditioner, since the pressure equilibrating member and the bypass unit are independently equipped in the air conditioner, there are problems of complicating the construction of the air conditioner and requiring a large installation space, resulting in decrease of installation efficiency and increase of installation costs.

SUMMARY OF THE INVENTION

[0025] The present invention has been made to solve the above problems, and it is an object of the present invention to provide an air conditioner which comprises a pressure equilibrating member with a bypass function, thereby simplifying the construction of the air conditioner while reducing installation space and costs, and a method for controlling the same.

[0026] In accordance with an aspect of the present in-

vention, the above and other objects can be accomplished by the provision of an air conditioner, comprising: at least one compressor for compressing a refrigerant; an outdoor heat exchanger connected to a discharge pipe of the compressor for heat exchanging the refrigerant discharged from the discharge pipe with outdoor air; an expansion mechanism for expanding the refrigerant discharged from the outdoor heat exchanger; an indoor heat exchanger for heat exchanging the refrigerant having passed through the expansion mechanism with indoor air; a pressure equilibrating member for connecting a suction pipe and the discharge pipe of the compressor and maintaining pressure equilibrium between the suction pipe and the discharge pipe of the compressor when the compressor stops operating; and a pressure reducing member equipped to the pressure equilibrating member for reducing a pressure of the refrigerant flowing from the discharge pipe to the suction pipe.

[0027] The pressure equilibrating member may comprise a connecting tube for connecting the suction pipe and the discharge pipe of the compressor, and an opening/closing valve equipped to the connecting tube for opening/closing the connecting tube.

[0028] The pressure reducing member may comprise a capillary tube equipped to the connecting tube to reduce the pressure of the refrigerant discharged in a state of high temperature and high pressure gas from the compressor.

[0029] The capillary tube may be located ahead of the opening/closing valve within the connecting tube.

[0030] The discharge pipe of the compressor may be provided with a backflow preventing member for preventing the discharged refrigerant from flowing in reverse.

[0031] The backflow preventing member may comprise a check valve.

[0032] The at least one compressor may comprise a plurality of compressors.

[0033] The air conditioner may further comprise a common accumulator for connecting the plurality of compressors.

[0034] Suction pipes of the compressors may be connected to a discharge part of the common accumulator.

[0035] In accordance with another aspect of the invention, a method for controlling an air conditioner, comprising the steps of: controlling a flux of a refrigerant via periodically opening opening/closing valves 83 and 85 equipped to connecting tubes 82 and 84 for connecting a suction pipe and a discharge pipe of a compressor 61, so as to reduce the flux of the refrigerant discharged from the compressor 61 when a load is lower than a capacity of the compressor 61 under operation; and equilibrating pressure between the suction pipe and the discharge pipe of the compressor 61 via opening the opening/closing valves 83 and 85 so as to maintain pressure equilibrium between the suction pipe and the discharge pipe of the compressor 61 when the compressor 61 stops operating.

[0036] In the construction of the air conditioner and the

method for controlling the same, which has the capillary tube incorporated to the pressure equilibrating member, the pressure equilibrium between the suction pipe and the discharge pipe of the compressor is maintained when the compressor stops operating, and a discharge flux of the refrigerant from the compressor is appropriately controlled even if the cooling load is lower than the capacity of the compressor under operation, thereby simplifying the construction of the air conditioner while minimizing the installation space thereof through omission of a separate bypass unit, leading to reduction in costs.

[0037] Moreover, when the compressor stops operating, the refrigerant flows in the suction pipe in a state of being reduced in pressure after passing through the capillary tube, thereby reducing vibration caused by a rapid pressure difference between the suction pipe and the discharge pipe of the compressor during pressure equilibration.

[0038] Moreover, since the air conditioner of the invention does not require the separate bypass unit, the number of components to be controlled by a controller is reduced, thereby reducing controller load.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] The foregoing and other objects and features of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a constructional view schematically illustrating a conventional air conditioner;

Fig. 2 is a constructional view schematically illustrating an air conditioner according to the present invention; and

Fig. 3 is a constructional view illustrating an operating state of the air conditioner according to the present invention when a cooling load is lower than a capacity of a compressor of the air conditioner.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0040] Preferred embodiments will now be described in detail with reference to the accompanying drawings.

[0041] Fig. 2 is a constructional view schematically illustrating an air conditioner of the invention, and Fig. 3 is a constructional view illustrating an operating state of the air conditioner according to the invention when a cooling load is lower than a capacity of a compressor of the air conditioner.

[0042] As shown in Figs. 2 and 3, the air conditioner according to the invention comprises: a plurality of compressors 61; a common accumulator 64 connected to respective suction pipes of the compressors 61; an outdoor heat exchanger 65 connected to respective discharge pipes of the compressors 61 for heat exchanging the refrigerant discharged from the discharge pipes with outdoor air; an expansion mechanism 66 for expanding

the refrigerant discharged from the outdoor heat exchanger 65; an indoor heat exchanger 67 for heat exchanging the refrigerant having passed through the expansion mechanism 66 with indoor air; a pressure equilibrating member for connecting the suction pipes and the discharge pipes of the compressors 61 and maintaining pressure equilibrium between the suction pipes and the discharge pipes of the compressors 61 if the compressors 61 stop operating; and a pressure reducing member equipped to the pressure equilibrating member for reducing a pressure of the refrigerant flowing from the discharge pipes to the suction pipes.

[0043] As with the conventional air conditioner, the air conditioner of the invention also generally consists of an indoor unit 70 which has the indoor heat exchanger 67 and the expansion mechanism 66 equipped therein, and an outdoor unit 60 which has the compressors 61, the common accumulator 64 and the outdoor heat exchanger 65 equipped therein.

[0044] The outdoor unit 60 is provided with an outdoor refrigerant discharge pipe 74 for guiding the refrigerant discharged from the outdoor heat exchanger 65 into the indoor unit 70, and an outdoor refrigerant suction pipe 75 for guiding circulation of the refrigerant discharged from the indoor unit 67 into the common accumulator 64.

[0045] The indoor unit 70 is provided with an indoor refrigerant suction pipe 76 for suctioning the refrigerant from the outdoor unit 60, and an indoor refrigerant discharge pipe 77 for discharging the refrigerant from the indoor unit 70 to the outdoor unit 60.

[0046] The outdoor refrigerant discharge pipe 74 is connected to the indoor refrigerant suction pipe 76 via a first service valve 78, and the outdoor refrigerant suction pipe 75 is connected to the indoor refrigerant discharge pipe 77 via a second service valve 79.

[0047] Herein, the compressors 61 will be described as comprising two constant speed compressors, which are connected to each other by means of the common accumulator 64.

[0048] The compressors 61 comprise first and second compressors 62 and 63, each of which has a suction pipe and a discharge pipe connected thereto in order to suction and discharge the refrigerant, in which the suction pipes comprise first and second suction pipes 68 and 69 provided to the first and second compressors 62 and 63, respectively.

[0049] One side of the common accumulator 64 is connected to the first and second suction pipes 68 and 69, while the other side of the common accumulator 64 is connected to the outdoor refrigerant suction pipe 75.

[0050] The discharge pipes are first and second discharge pipes 71 and 72 connected to the first and second compressors 62 and 63, respectively, to discharge a gaseous refrigerant compressed at high temperature and high pressure by the first and second compressors 62 and 63. The first and second discharge pipes 71 and 72 are combined with a third discharge pipe 73 which guides the refrigerant discharged from the first and second com-

pressors 62 and 63 towards the outdoor heat exchanger 65.

[0051] The first and second discharge pipes 71 and 72 are respectively equipped with first and second check valves 80 and 81 so as to prevent the gaseous refrigerant of high temperature and high pressure from flowing in reverse towards the first and second compressors 62 and 63.

[0052] The pressure equilibrating member comprise a first pressure equilibrating member for maintaining pressure equilibrium between the suction pipe and the discharge pipe of the first compressor 62 when the first compressor 62 stops operating, and a second pressure equilibrating member for maintaining pressure equilibrium between the suction pipe and the discharge pipe of the second compressor 63 when the second compressor 63 stops operating.

[0053] The first equilibrating member comprises a first connecting tube 82 for connecting the first suction pipe 68 and the first discharge pipe 69 of the first compressor 62, and a first opening/closing valve 83 equipped to the first connecting tube 82 for opening/closing the first connecting tube 82.

[0054] The second equilibrating member comprises a second connecting tube 84 for connecting the second suction pipe 69 and the second discharge pipe 72 of the second compressor 63, and a second opening/closing valve 85 equipped to the second connecting tube 84 for opening/closing the second connecting tube 84.

[0055] The pressure reducing member comprises first and second capillary tubes 86 and 87 equipped to the first and second connecting tubes 82 and 84 to reduce the pressure of the gaseous refrigerant discharged in a state of high temperature and high pressure from the first and second compressors 62 and 63, respectively.

[0056] Here, the first and second capillary tubes 86 and 87 are preferably located ahead of the first and second opening/closing valves 83 and 85 within the first and second connecting tubes 82 and 84.

[0057] Meanwhile, the air conditioner of the invention may further comprise a controller (not shown) for controlling the opening/closing valve of any one of the compressors 62 and 63, which will stop operating, to be opened while controlling the opening/closing valve of the compressor under operation to be periodically opened when a load is lower than a capacity of the compressor under the operation.

[0058] Operation and a method of controlling the air conditioner constructed as described above will now be described.

[0059] First, as shown in Fig. 2, when both the first and second compressors 62 and 63 are operated, refrigerants respectively compressed by the first and second compressors 62 and 63 are combined in the third discharge pipe 73 after being discharged through the first and second discharge pipe 71 and 72, and flow in the outdoor heat exchanger 65.

[0060] The refrigerant having flown in the outdoor heat

exchanger 65 is subjected to heat exchange with outdoor air to dissipate heat to the outdoor air while being condensed.

[0061] Then, the condensed refrigerant flows in the indoor unit 70 through the outdoor refrigerant discharge pipe 74, and is expanded to the refrigerant having low temperature and low pressure while passing through the expansion mechanism 66. The expanded refrigerant absorbs heat of indoor air while passing through the indoor heat exchanger 67, and is then evaporated.

[0062] As a result, the indoor air is deprived of the heat, whereby a room is cooled.

[0063] Meanwhile, as shown in Fig. 3, if a cooling load is lower than a capacity of the first and second compressors 62 and 63 during the operation, the controller (not shown) performs control of a refrigerant flux such that the first and second opening/closing valves 83 and 85 are periodically opened.

[0064] In other words, if the cooling load is lower than the capacity of the first and second compressors 62 and 63 during the operation, since it is necessary to set a cooling load which is lower than the capacity of the first and second compressors 62 and 63, the first and second opening/closing valves 83 and 85 are periodically opened so as to reduce the flux of the refrigerant discharged from the first and second compressors 62 and 63.

[0065] When the first and second opening/closing valves 83 and 85 are opened, some portion of the refrigerant flows in the first and second suction pipes 68 and 69 after being discharged from the first and second compressors 62 and 63, and thus the flux of the refrigerant discharged from the first and second compressors 62 and 63 is reduced.

[0066] At this time, the refrigerant of high temperature and high pressure having flown to the first and second connecting tubes 82 and 84 from the first and second discharge pipes 71 and 72 is reduced in pressure while passing through the first and second capillary tubes 86 and 87.

[0067] Then, if the load appropriately corresponds to or is higher than the capacity of the first and second compressors 62 and 63, the controller (not shown) controls the first and second opening/closing valves 83 and 85 to be closed.

[0068] Meanwhile, the case where one of the first and second compressors 62 and 63, in particular, the first compressor 62, stops operating will be described hereinafter.

[0069] When the first compressor 62 stops operating, the controller (not shown) performs a pressure equilibrating step, by which the first opening/closing valve 83 is opened so that pressure equilibrium between the first suction pipe 68 and the first discharge pipe 71 can be maintained.

[0070] When the first opening/closing valve 83 is opened, the refrigerant, which has already been discharged from the first compressor 62, flows to the first suction pipe 68 through the first connecting tube 82.

[0071] Accordingly, even after the first compressor 62 stops operating, the controller reduces a pressure difference between the first suction pipe 68 and the first discharge pipe 71 of the first compressor 62 so as to maintain the pressure equilibrium therebetween, so that when the first compressor 62 operates again, the operation of the first compressor 62 is smoothly performed.

[0072] Moreover, the refrigerant flows in the first suction pipe 68 in a state of being reduced in pressure through the first capillary tube 86, thereby reducing vibration occurring upon pressure equilibration.

[0073] Advantageous effects of the air conditioner and the method for controlling the same will be described as follows.

[0074] As apparent from the above description, the air conditioner has the capillary tube incorporated to the pressure equilibrating member, so that the pressure equilibrium between the suction pipe and the discharge pipe of the compressor is maintained when the compressor stops operating, and so that the discharge flux of the refrigerant from the compressor is appropriately controlled even if the cooling load is lower than the capacity of the compressor under operation, thereby simplifying the construction of the air conditioner while minimizing an installation space thereof through omission of a separate bypass unit, leading to reduction in costs.

[0075] Moreover, when the compressor stops operating, the refrigerant flows in the suction pipe in a state of being reduced in pressure after passing through the capillary tube, thereby reducing vibration caused by a rapid pressure difference between the suction pipe and the discharge pipe upon pressure equilibration.

[0076] Moreover, since the air conditioner does not require the separate bypass unit, the number of components to be controlled is reduced, thereby reducing the load of the controller.

[0077] It should be understood that the embodiments and the accompanying drawings have been described for illustrative purposes and the present invention is limited only by the following claims. Further, those skilled in the art will appreciate that various modifications, additions and substitutions are allowed without departing from the scope and spirit of the invention as set forth in the accompanying claims.

Claims

1. An air conditioner, comprising:

at least one compressor 61 for compressing a refrigerant;
an outdoor heat exchanger 65 connected to a discharge pipe of the compressor 61 for heat exchanging the refrigerant discharged from the discharge pipe with outdoor air;
an expansion mechanism 66 for expanding the refrigerant discharged from the outdoor heat ex-

changer 65;

an indoor heat exchanger 67 for heat exchanging the refrigerant having passed through the expansion mechanism 66 with indoor air;

a pressure equilibrating member for connecting a suction pipe and the discharge pipe of the compressor 61 and maintaining pressure equilibrium between the suction pipe and the discharge pipe of compressor 61 when the compressor stops operating; and

a pressure reducing member equipped to the pressure equilibrating member for reducing a pressure of the refrigerant flowing from the discharge pipe to the suction pipe.

2. The air conditioner as set forth in claim 1, wherein the pressure equilibrating member comprises a connecting tube 82 or 84 for connecting the suction pipe and the discharge pipe of the compressor 61, and an opening/closing valve 83 or 85 equipped to the connecting tube 82 or 84 for opening/closing the connecting tube 82 or 84.

3. The air conditioner as set forth in claim 2, wherein the pressure reducing member comprises a capillary tube 86 or 87 equipped to the connecting tube 82 or 84 for reducing a pressure of the refrigerant discharged in a state of high temperature and high pressure gas from the compressor 61.

4. The air conditioner as set forth in claim 3, wherein the capillary tube 82 or 84 is located ahead of the opening/closing valve 83 or 85 within the connecting tube 82 or 84.

5. The air conditioner as set forth in claim 3, wherein the discharge pipe of the compressor 61 is mounted with a backflow preventing member for preventing backflow of the discharged refrigerant.

6. The air conditioner as set forth in claim 5, wherein the backflow preventing member comprises a check valve 80 or 81.

7. The air conditioner as set forth in claim 6, wherein the at least one compressor 61 comprises a plurality of compressors.

8. The air conditioner as set forth in claim 7, further comprising:

a common accumulator 64 for connecting the plurality of compressors 61.

9. The air conditioner as set forth in claim 8, wherein suction pipes of the plurality of compressors 61 are connected to a discharge part of the common accumulator.

10. A method for controlling an air conditioner, comprising the steps of:

controlling a flux of a refrigerant in such a manner of periodically opening an opening/closing valve 83 or 85 equipped to a connecting tube 82 or 84 for connecting a suction pipe and a discharge pipe of a compressor 61, so as to reduce the flux of the refrigerant discharged from the compressor 61 when a load is lower than a capacity of the compressor 61 under operation; and
equilibrating pressure between the suction pipe and the discharge pipe of the compressor 61 in such a manner of opening the opening/closing valve 83 or 85 so as to maintain pressure equilibrium therebetween when the compressor 61 stops operating.

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FIG. 1 (Prior Art)

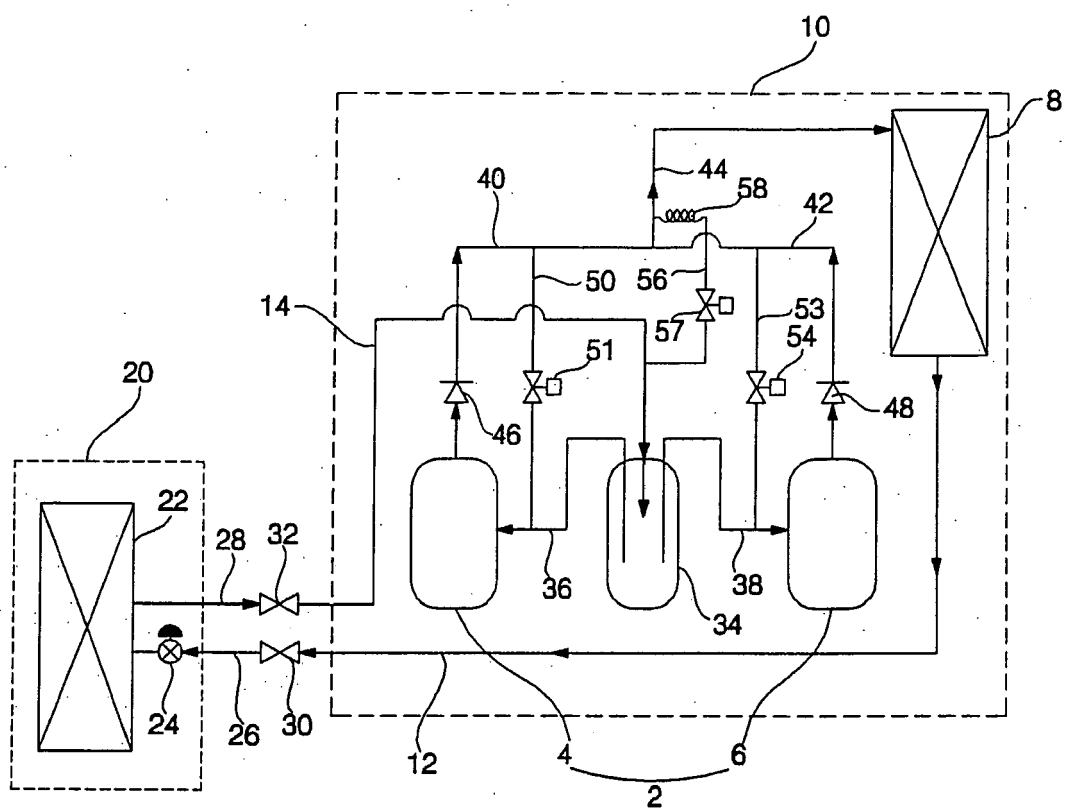


FIG. 2

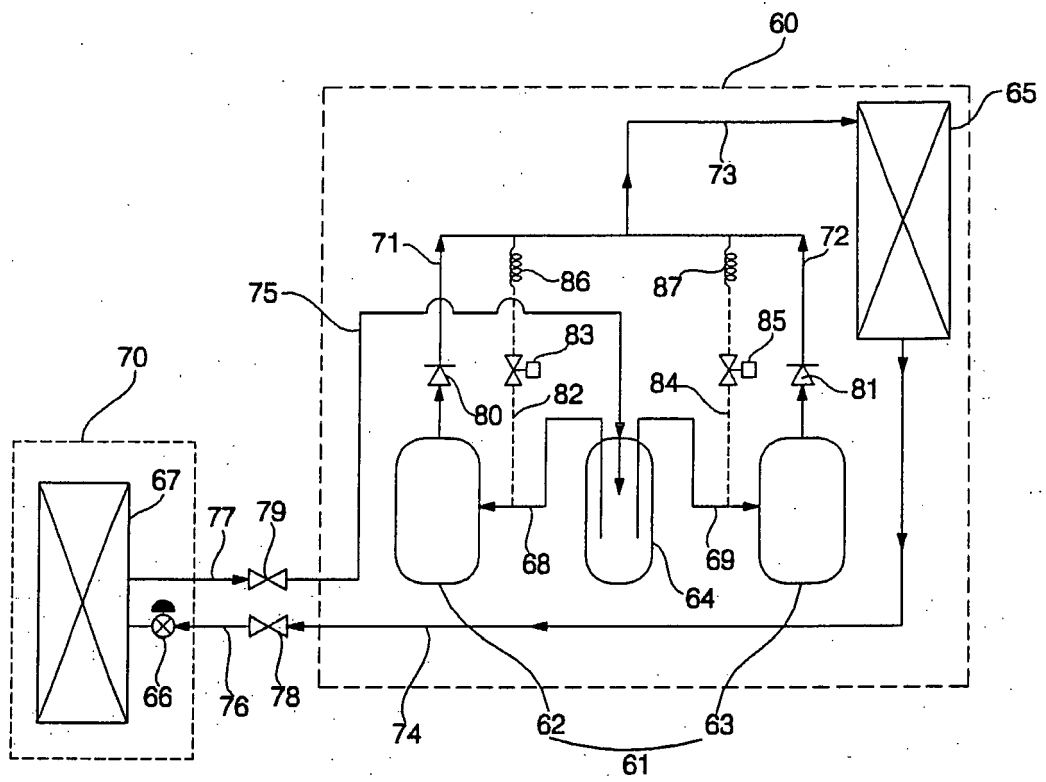


FIG. 3

